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Bikini Atoll Field Studies

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We have tested three effective ways to minimize the amount of radioactive cesium in the food chains at Bikini Atoll.

The most significant radionuclide remaining from tests of nuclear weapons at Bikini Atoll is cesium-137, which would account for about 90% of the total radiation dose to any population returning to the islands of Bikini and Eneu. One of the more significant exposure pathways for humans is the terrestrial food chain (particularly coconut). We are evaluating three different ways to minimize the potential exposure to cesium-137 via this pathway so that the displaced Marshallese can safely return.

In one contaminated 1.6-hectare test plot, we removed all trees and excavated the top 40 cm of soil from half of it, leaving the rest as a control. We planted about 30 different plant species in both plots and kept them irrigated and fertilized, except for half the plants in the control plot, which received no fertilizer.

Excavation reduced the average cesium-137 external exposure rate by an order of magnitude, and preliminary data for cesium-137 in food crops show a similar decrease. However, this option is expensive (about \$60 million), requires removal of all vegetation and the fertile, water-retaining topsoil, and requires a significant long-term commitment, since the remaining soil grows only inferior crops unless it is fertilized and watered correctly.

We also tested the effect of using fertilizer without excavation. Because atoll soils contain little potassium, plants readily absorb its chemical analog, cesium. To see whether

additional potassium would change this behavior, we applied potassium fertilizer at a rate of about 625 kg per hectare per year to four coconut trees on Eneu Island. Figure 1 shows the tenfold reduction in cesium-137 concentration in the dried meat and fluid from one tree (typical of all).

We subsequently repeated the experiment with trees on Bikini Island, where cesium-137 concentrations are ten times those on Eneu Island, and obtained a similar reduction, although more time is required to determine the final level of concentration. Over the same time period, analyses of coconuts from 50 control trees on the two islands showed very little change in cesium-137 concentration.

We will continue to analyze fruit from the original four trees over the next two years to see if the effect is long lasting. We have also started a 6-hectare field trial within the coconut grove to test the effect of application rate. Even at the original application rate, this option would cost only about \$3 million.

We also tested the more expensive (\$6 million) concept of using sea water to displace cesium-137 from the soil.

We cleared all trees and active root systems from a 1-hectare plot and applied a total of 20 m³ of sea water with a sprinkler system. After waiting for one rainy season to flush out the excess salt, we planted coconuts, pandanus, and many other food crops, all of which grew well. We found only 0.4 to 4% as much cesium-137 in crops from the seawater-irrigated plot as from the control plot, although only 4% of the cesium-137 inventory in the soil was removed to the groundwater.

We will be monitoring the crops from the treated plot over the next two years to see if this effect is long lasting. We are also testing the effect of sea water on mature coconut trees. ☐

Key Words: Bikini Island; cesium-137; Eneu Island; food chain; radioactive contamination.

Fig. 1

How the application of potassium fertilizer affected the concentration of cesium-137 in dried coconut meat and coconut fluid as a function of time. Dates are given as year and month; 81/5 is May 1981.

